Workshop on NDT and SHM requirements for wind turbines

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About FORCE Technology

We:
• are one of the leading technological service companies on the international market
• are independent and self-governing
• have a strong Scandinavian base

Our:
• work is based on the most recent technological knowledge
• development budget is more than 26 mill. EUR
We transform highly specialised engineering knowledge into practical and productive solutions for a number of industries.

As a GTS company, we are dedicated to develop and use technologies and new knowledge for the benefit of Danish companies and the Danish society as a whole.
Blades, Towers and Foundations
production and on-site

FORCE Technology
FORCE and Wind Turbines

• Testing prototype blades for the pioneering Danish wind turbine industry
Ultrasonic Testing of production blades
Objective

- Very fast inspection of large blades, typically 2-5 hours

- One man operation, level 1 UT for data collection

- Full digital documentation, data analysis review, comparison to in-service inspection data
Challenge – NDT prioritizing

• Blade design
  – Critical defects
  – Size and measuring tolerances

• Blade production
  – Critical defects
  – Inspection time
Defect types

Failures and Defects detectable by Automated Ultrasonic Inspection

- Blade shell
- Adhesive
- Beam
- Thickness
- Kissing bond
- Delamination
- Dry area
- Gelcoat disbond
- Missing adhesive
- Width and placing of adhesive
Defect type: Wrinkles

Lower down, the amplitude is 2.17 mm, half wave width 40 mm (~3° fibre deviation). A foreign object is visible in the composite structure – left hand of the wrinkle.
Automated Scanner Systems – AMS-71
New blade scanner system AMS-71 PA²

FORCE Technology
P-Scan PA² evolution

P-Scan PA² probes and probe holder
Data presentation
Vacuum crawler for on-site blade inspection

- Patented crawler with one or more vacuum-distribution chambers
- Remote controlled movement on any blade orientation
- Self propelled device for transporting sensors
  - Ultrasonic, Visual, Thermal, SAR-Radar, Sherography …
- Flexible belts with absorbency on vertical, rough and uneven surfaces
- Dimensions: 580 x 710 x 195 mm
- Weight: 20 kg
- Lift capacity: up to 40 kg
- Speed: 50 mm/s (3 m/min)
Technical specifications

- Channels 32/64 to 256/512 PA, 8 to 32 PE
- Large frequency range, 0.05 to 30 MHz
- High transmitter amplitude, 80 to 200 V, rectangular, bipolar
- **High dynamic range for amplifier, >100 dB @ 5 MHz**
- Input noise, (high signal to noise ratio) <2 nV/√Hz
- Integrated scanner controller for up to 15 axis
Cloud solution for inspection data

Data upload from scanner
Manual analysis
Automated analysis

The P-scan Stack System
Developed for operators by operators
Research Projects

Made Spir
- Siemens and FORCE: Automated system for Automated Measurement of actual blade geometry.

Made Digital

RELIABLE BLADE
- DTU-Vestas-FORCE-IBM-Dantec Dynamic and others: Improving Blade Reliability through Application of Digital Twins over Entire Life Cycle
RELIABLE BLADE

The P-scan Stack System
Developed for operators by operators